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Geological
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A GEOLOGICAL RECONNOISANCE OF THE ARKANSAS RIVER.

BY

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A GEOLOGICAL RECONNOISANCE OF THE ARKANSAS RIVER.

In presenting myself before this body with a simple bird's-eye view of one of the greatest tributaries of the "Father of Waters," I feel a diffidence, arising from the paucity of facts which have fallen under my notice, but I am urged to proceed, in consequence of the very limited and imperfect information which I had been able to acquire from books, respecting this unknown region. Arkansas is a vast state, embracing within its borders a varied surface of different geological characters. It is usually the case, that wherever the people are ignorant of the wealth beneath and around them, two classes are found, the one *doubters*, the other possessed of extravagant opinions respecting the fancied value of the mineralogical sources they possess. So I found it in this interesting region.

The Arkansas river is a much more important tributary than is generally imagined, rising amidst the Rocky Mountains, bringing the melted snows and rains, from *Pike's Peak* and the *Spanish Peaks*, in an elevated region which furnish streams that run in almost every direction, it receives many tributaries of more or less consequence, as it sweeps through New Mexico and the Indian Territory, entering this State on its western border at Fort Smith, it passes diagonally toward the south-east, to its confluence with the Mississippi at Napoleon. During this progress it has run over a distance of 2500 miles! The supply of atmospheric moisture in the Great Western Desert being cut off by the height of the Rocky Mountains, we do not find the size of this stream commensurate with its length; it is however, navigable during a portion of the year, for a distance of 700 miles by steamboats.

The extent of this reconnoisance will be within the range of its navigable water, and for convenience, I propose to divide it into five sections, characterized by the geological formation through which it passes. Ascending the river, they will be met in the following order: *Alluvial, Tertiary and Cretaceous, Eruptive and Metamorphic, Coal Formations, and Carboniferous Limestone.*

Alluvial.

The traveller who has descended the Mississippi must have been struck with the immense amount and extent of the alluvial deposit, seldom interrupted by a bluff of moderate elevation. The characteristics of this formation, made up, as it has been, by the detritus of many rivers passing through the various rocks, from the coal-bearing strata on the Ohio, the silurian limestones, and the black lacustrine prairies, with their peaty soil, are those of a fine sandy loam, occasionally almost a stiff clay.

After leaving the "Father of Waters," the ascent of Arkansas very soon presents to the observant traveler unmistakeable indications that the stream, upon whose bosom he is now floating, has been busily at work for ages, in wearing down and transporting the materials of a sandstone formation. Broad sandbars accumulate about every obstruction; a sunken steamer or barge is soon covered, while the terrible snags that have given this stream a fearful character, furnish neuclei about which accumulations soon gather, soon, however, to be again disturbed by the shifting current of a varying channel during subsequent inundations.

The banks of this river are equally characteristic of the origin of the alluvium; though twenty-five feet above low water, they are still subject to frequent inundations, and present, where cut, in the bends of this changing river, abrupt banks of sand that exhibit beautiful sections, in which the history of thousands of inundations may be distinctly traced. The successive deposits, separated by a line of black mold vary from an inch or a few inches to three, four, and even five feet in thickness, without any seam or mark to indicate that each deposit was not the result of a single overflow. This will appear the less improbable and surprising when it is recollected that during periods of inundation the stream exceeds its banks, especially within fifty miles of its mouth, to which distance it is often dammed back by the floods of the Mississippi.

A peculiar feature of this river, particularly in its lower portion, is the remarkable number of its turns or bends, so that the water flows toward almost every point of the compass within the distance of a few miles; here, of course, we find a prolific source of change, to which both natural and human efforts contribute, producing, as a result, a considerable shortening of the aggregate distance and a cor-

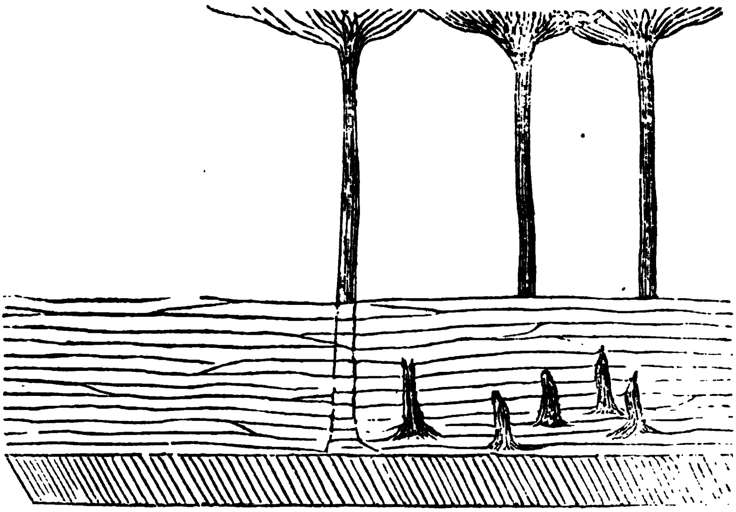
EARTH SC

respondent increase in the rapidity of the current. These *cut-offs* are frequently but a few hundred yards in length where the river had formerly made a loop or circuit of many miles. The "old river" may be traced, oftentimes, to a distance of several miles on either side of the present stream, by depressions, curved banks, and lakes of elongated form, which are so palpable that the most inexperienced would not hesitate a moment in determining these marks to be the relics of an ancient channel. I was not able to learn the width of this extraordinary alluvium, but it must embrace many miles, frequently interspersed with sunken portions, in which the finer deposits from still waters have subsided, forming strata of dark blue clay, upon which the *Cypress*, the growth of centuries, has flourished in rank luxuriance. It is a matter of common belief, even among the least observant of the population, that the river has at one time or another traced its channel through every portion of this formation.

One of the most interesting characteristics of the river is the silting up of deserted channels, which frequently takes place to a very great extent at the same time and during the same freshet which has produced the cut-off; this is, of course, the most remarkable at the eddy in the upper portion of the loop, and I saw several points where the stream had been nearly obliterated by sand within a very few years, and these bars were covered by a thick growth of the omnipresent *Cotton-wood tree*, the great aid of nature in this process of land-making; all such groves were evidently of but a few years' growth, and beyond them it was easy to trace the venerable and majestic specimens of the same tree, skirting the elevated margin of the ancient river, where, too, could frequently be seen the plantations and buildings, that but a few short years ago were conveniently placed within reach of the steamboat.

In addition to the individual efforts of settlers upon this stream, the government is contributing largely toward the shortening process by a continuous system of dykes, which are intended to confine the water of overflows within a definite channel. The effects of this great work may be anticipated, and it may be assumed that they will produce a straightening, and more rapid current; but it may also be apprehended that the difficulty will not be entirely obviated, for it has been elsewhere observed, that where streams are confined by dykes the bottom fills up and rises in the same ratio with the surface of the water.

I shall attempt to describe a single section of the alluvium, by way of illustrating the deposits and changes of the bed of the stream. Look at Fig. 1, and imagine a bluff of sand, rising directly from the



[Fig. 1.]

water to a height of twenty-five feet; at low water mark is a stratum of a foot or more in thickness of blue mud or clay, firmly rooted in this, and projecting upward, are numerous antique stumps and knees of the cypress, which are so characteristic that no one can mistake them; above the clay, and among these stumps, are successive layers of the peculiar sandy soil of the river bottoms, each of which is separated from the next by a lamina of decayed vegetable mold or surface soil, showing that a certain period had elapsed between the deposits, during which vegetable life had luxuriated, before it was again covered by the next overflow. These strata vary somewhat in their character, though generally alike; upon the surface is usually found the cotton-wood, but here and there, even when the sandy bank had been raised above the usual high water mark, the noble form of a gigantic cypress rears its head high aloft as though frowning upon the upstarts occupying the position of its fallen mates, and with no prospect of a successor in this uncongenial soil. That this is no fancy sketch I had an opportunity of verifying, by tracing the trunk from the blue clay at the base of the bluff through the subsequent deposits of sand at a point where the river had recently made an inroad into its bank: beside, the natural habitat of this tree is never in a sandy soil.

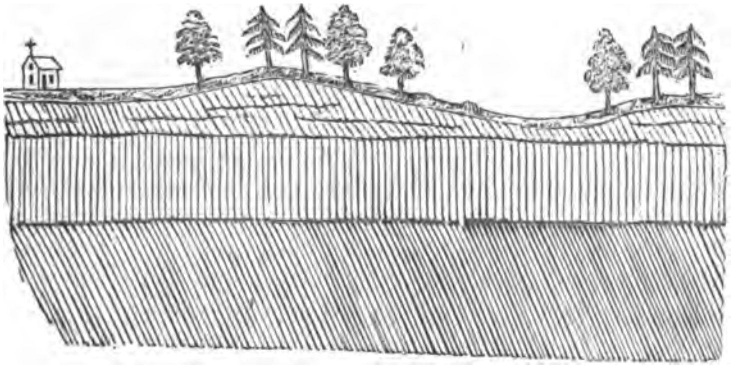
The alluvial region constitutes the most important part of the state, in regard to the great southern staple; upon the more elevated banks, and especially upon the borders of the lakes and ancient river bed, on either side of the present channel, vast plantations occupy extensive tracts, some of which are so elevated as to be entirely free from overflows. The fertility of the bottom lands, however, is so great as to attract settlers, who frequently suffer loss by the immense amount of sand sometimes deposited during the spring and summer freshets. This detritus of sand occasionally amounts to three or four feet in thickness, entirely overwhelming whole fields of corn and cotton, to the great injury of the planter; I saw several instances of this, which presented a scene of terrible devastation, but was credibly informed that the sandy deposit very soon acquired a capability of furnishing abundant crops, and further, that the fields which had thus been entirely submerged by the great freshet of 1834, had regained their fertility, and then a more recent flood removed the entire deposit, bringing the farmer back to his old level.

I have extended the discussion of the alluvial portion of the State because of its vast importance in an economical point of view, as well as the great breadth which it occupies; it must be remembered, also, that in my sub-divisions of the river, I have designated the lower portion as the alluvial, but a similar formation is continuous with the stream throughout its length, characterized everywhere, by immense growths of cotton-wood, and by cypress swamps.

After having ascended the river some two hundred miles, the traveler is delighted to see land rising far beyond the influence of the surplus waters which flow through this channel. Whatever may be the character of the lands back from the river at any lower point, I was able to learn only upon uncertain authority, but believe that these higher tables extend some distance further to the eastward and southward. The consideration of this region brings me to the discussion of the next subdivision,

The Tertiary and Cretaceous.

This portion of the state is supposed to extend from east to west, or nearly in that direction, in a belt of perhaps 100 miles in width, southerly of the Masserne Mountains, skirting them from Little Rock to the Hot Springs, and thence westwardly, and extending down the river to Pine Bluffs, which are situated on the high lands just now alluded to, and which are named from the changed aspect of vegetation. Here we find the Pinusinops, or Yellow Pine, which constitutes a new feature in the landscape, very acceptable to one who has just passed through the monotonous alluvial region below. With these are associated scrubby oaks, and a varid undergrowth, among which the pale green of the *Holly* also enlivens the scene, and agreeably replaces the cane-brakes that constitute the subordinate vegetation among the dense forests of *Cotton-wood*, *Sweet Gum*, *Cypress*, *Willow*, *Sycamore*, *Elm*, and *Walnuts*, of the fertile bottom lands. Here, however, with this change of vegetation, we find a corresponding change in the character of the soil, which is shallow, thin, and sandy, resting upon the remarkable clays and sands, which we come next to describe, and which constitute here, as at other points in this section of the river, the peculiar bluffs; a section of which (Fig. 2), taken at random from my sketch book, gives us, beneath a few inches of soil, thick layers of *Whitish Clay*, five to twenty feet, in which are streaks of bright red, irregularly distributed; next, in descending order, occurs *fifteen to twenty feet* of *Yellow Clay*, and below this *twenty-five feet* or more of *Blue Clay*, constituting, generally, about seventy-five feet in all, and presenting a bold appearance. These cliffs are exceedingly interesting, from their decided character and distinct markings. The lower stratum was concealed by the water, so that I had no opportunity of observing its nature, but it is reasonable to infer that it is more arenaceous than the superincumbent mass, because it seems to have washed out in many places, causing the subsidence or sliding of immense masses of earth, which have in many cases slidden down into the river, with the natural forest growth still standing upon them, sometimes erect and sometimes more or less tilted.



[Fig. 2.]

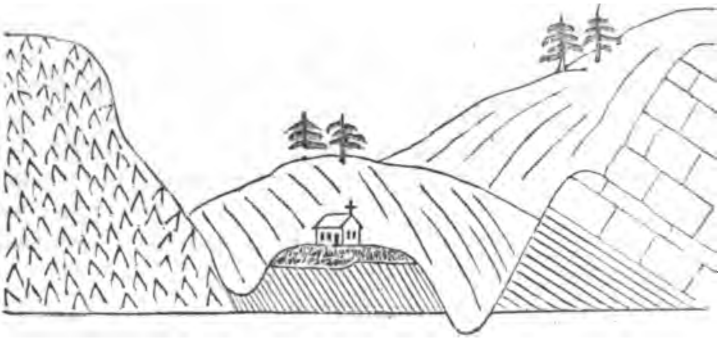
In assigning this portion of the river to the tertiary and cretaceous period, I feel much at a loss for want of more definite and positive information than I was able to obtain. Cretaceous fossils, such as *Exogyra*, and others, have been brought me from the region in question, westward of Pine Bluff, and fossils of a similar geological character were represented as occurring in the prairies east of the river, and between it and White River. With regard to the bluffs just mentioned, although I was not able to collect, or even to hear of their containing, any fossils, I am disposed to consider them as belonging to the *Eocene* period, and am strongly inclined to trace a close analogy between them and the Chickasas Bluffs, on the Mississippi. Their relation to the high grounds which extend to that river at Helena, is, to my mind, very apparent. This formation extends, as before noted, in undulating swells to the low mountains of upheaval, against which they rest, and where a stratum of calcareous rock occurs, which is made up of comminuted shells of a cretaceous appearance and character.

Eruptive and Metamorphic—Region of Upheaval.

As before hinted, the traveler upon this long and tortuous stream, looks forward with anxiety, after passing the continuous deposits of finely triturated ingredients, among which he rarely sees even a small pebble, to a spot which, from its name, he may consider *terra firma.* It comes when he least expects it; the dense and tall forests, and the frequent turns in the stream, intercept an extended view. Broad bottoms and large plantations recall scenes which have been oft repeated during his passage through the alluvial region, when, suddenly appears, upon a gentle elevation, the city of *Little Rock,* the capital of the State. Here, when the steamboat is made fast to firm rocks of a contorted character, slaty, and interrupted with bands of a hard and resistive nature, he feels at once transported to a "primitive" region.

The study of the belt of rocks which cross the stream at this point, furnishes much for investigation. Rising from the river at this place is a slate cliff of some seventy-five feet in height, with a dip of about 60°, inclining west of north, the axis of elevation being a little south of west. This band stretches beyond the Hot Springs on the west, and also for some distance to the east of the river. At the steamboat landing there is a decided convolution of strata, or anti-clinal axis. [See Fig. 3.]

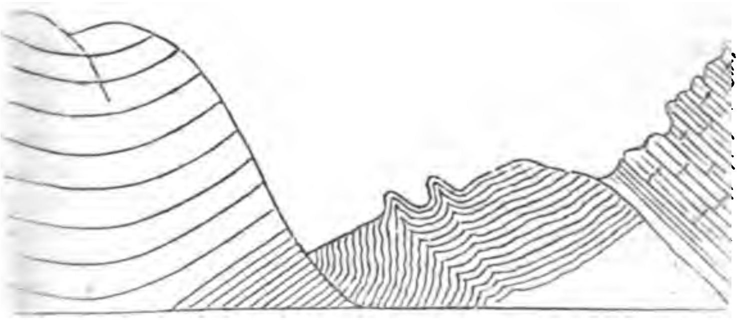
The rocks are all abruptly cut off at a certain elevation, and upon them, lying unconformably, a stratum of one foot in thickness was observed, which is composed, almost exclusively, of fragmentary shells, that bore decided evidence of a cretaceous origin, although they were so comminuted, and so firmly compacted that I was unable to make out the character of a single specimen. Upon this, and in most places directly upon the edges of the slate, rests a heavy deposit of sand and gravel, the latter chiefly silicious, and bearing the usually well marked characters of the drift formation; in places, however, it is largely mixed with fragments of slate, and of the beautiful white angular quartz, which occurs in distinct veins among the slate and associated sand rock of this region. Lying in this material a few large masses of greenstone trap rock were observed, bearing the appearance of having been subjected to a long and extended transportation; in lithological characters they resemble similar masses found in the boulder region of Ohio, and they are very distinct from any rock found in place.



[Fig. 3.]

The metamorphic strata of this region consist of slates and sandstones, or quartzose rocks, which have been indurated and changed by their proximity to the eruptive granite. They are characterized by transverse grains and seams of quartz, which is generally a pure white and highly crystalline. Among the slates layers are also found of a hard quartzose rock, which is sometimes more or less colored. The latter are evidently layers of silicious matter which have been changed, at the same time that the alluminous layers became slate; with regard to the veins, however, I was not able to satisfy myself whether they were the result of injection, during the eruptive period, or of seggregation of the silicious matter that collected, or was infiltrated into the cracks resulting from the upheaval. So nearly as I can recollect, the veins, of whatever size, were not observed to cross through one another, although, especially in the State, they frequently traversed that material in different directions. These veins were also observed in the silicious layers associated with the slate. The investigation of this subject is one of great interest, and will, I hope, attract the attention of some one having leisure for more critical and continued observation. The fragments of this resisting material have already been alluded to as mingled with the drift that lies upon the rolling plateau about Little Rock. They are, however, most abundant in the high hills immediately north of the slate formation, upon which rest the indurated sand rocks. The surface of these elevations is, in many places, so completely covered with masses of varying size as to be wholly unfit for agricultural purposes. These veins acquire a high degree of economic interest, from the fact that they form the matrix of Galena, which contains a large per centage of silver. Mines are worked a few miles from Little Rock, where shafts have been sunk to a considerable depth in exploring for this metal.

The scenery in this region is marked by gentle swells of rolling land upon the band of slate, bounded on the south by the low range of Granite Hills, and rising to the north into rounded eminences formed by the sand rock, which attain a height of from two to three hundred feet. The whole region north of the granite contains a growth of yellow pine, interspersed with oaks, but the traveler enjoys few opportunities of observing the hilly character of the country while passing along the river, except at those points where the stream has cut across a ridge and exposed sections of the rock, which form fine bold cliffs, as is beautifully illustrated by the section on the north bank of the river just above the capital, where the end of a ridge is exposed for a couple of miles, at a place known as Big Rock [Figs. 3 and 4]. This section forms one of the most beautiful illustrations of a synclinal axis that could be desired by the Geologist.

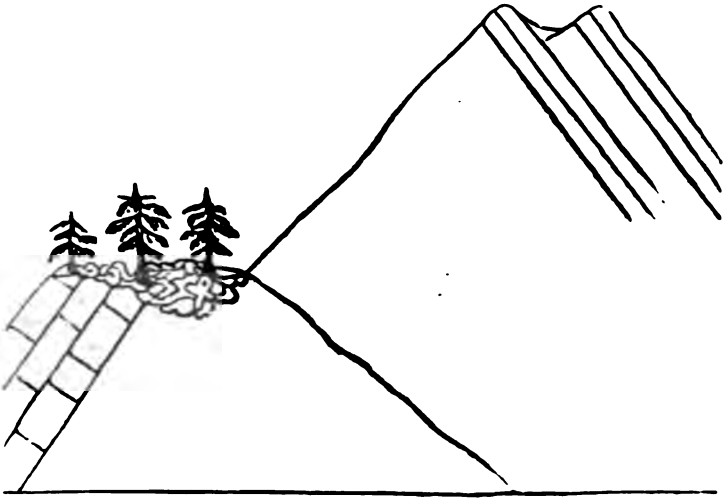


[Fig. 4.]

The difficulty of making observations arises from the fact of the immense amount of excavation which has been effected by this river, and that all the bottom lands are covered with a dense growth of cotton-woods, and other timber, which produces so perfect a screen as to limit the field of observation, except at a few points, where a long reach of the river enables the beholder to obtain an extended horizon. On this account, the traveler frequently passes a ridge within a couple of miles, without being conscious of any break from the dull monotony of the lowland forest of the alluvium. The only successful method of appreciating the beauty of the scenery in this region, is to clamber to the summit of a mountain, and thence observe the successive parallel ranges of hills, with the intervening excavations covered with their sea of forests; it was in this way that I discovered the Granite Hills, lying to the south of Little Rock, toward which I started with eager anticipation, and where I was delighted to find a satisfactory explanation of the upheaval and metamorphism in the ejected matter forming them. Here was a veritable granite, with its characteristic growth of scrubby oaks and alpine plants, among which I wandered, leaping from mass to mass of the sterile rock with a childish pleasure, which can only be appreciated by those who have experienced the delight of discovering an unheard of production, or one of which they have often heard but never seen, or, perhaps, more like that of one, who revisits, after a long absence, the familiar scenes and characteristics of the land of his birth and early youth.

I was not able at any point to trace the connection between the granite and the slate, because of the existence of the broad valley of the Fouche, which washes the base of the former. The latter rock, however, appears on the north bank of this stream, and is there inclined to the north except where plicated, in an anticlinal axis, as near the steamboat landing at the city, (See Fig. 3.)

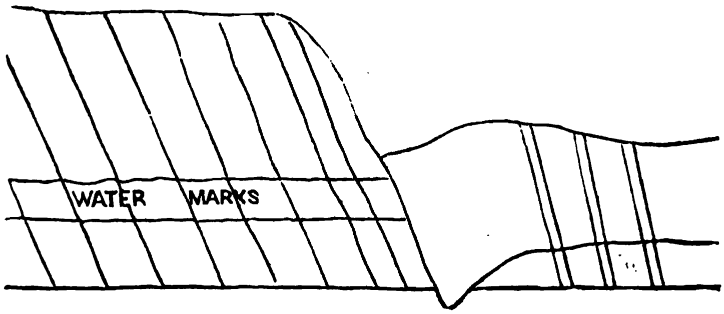
The region of upheaval embraces an extent of forty miles along the river, although it forms a band of perhaps fifteen miles in breadth; in this extent there are probably four anticlinal axes; that adjoining the granite, one above Big Rock, one at Mammelle [Fig. 5], and another at a creek, above Benedict's woodyard (see Fig. 5), to which further allusion will be made as we proceed with the description of this very interesting country. As already stated, a distinct synclinal axis occurs just above Little Rock, in which the beautifully exposed cliffs of altered sandstone may be traced with perfect distinctness, and, dipping beneath these on the one hand, and emerging from beneath them on the other, the slate is finely exposed (Figs. 3 and 4). The next section of interest is almost immediately adjoining, and consists of alternate layers of highly indurated silicious rocks and slates, which are exceedingly contorted and plicated, forming a most curious illustration of this extraordinary formation (Fig. 4). The superincumbent silicious rocks do not appear in this section, but occur in that immediately above (Fig. 4), where this metamorphic rock forms a remarkable eminence, which I have designated *The Peak.* It is the northern slope of the second anticlinal axis; the side parallel to the slate rises



[Fig. 5.]

gradually and smoothly to the height of three hundred feet; on the other side, however, the characteristics of the alternate layers of slates and consolidated sandstones present a fearfully rugged aspect, owing to the destruction of the former, leaving the latter in bold projecting masses, and difficult to represent on a small scale.

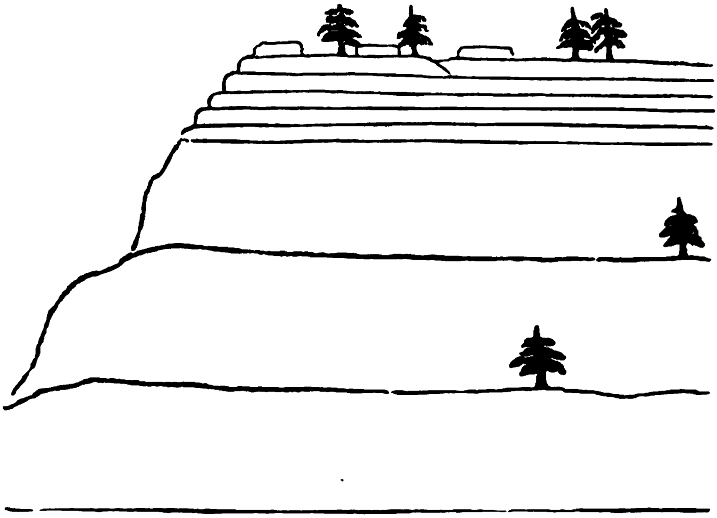
One of the most interesting of these anticlinalities is that which embraces the beautiful peak called the *Mammelle,* a title which appears to have been a favorite designation among the early French settlers for every regular and well defined elevation; the term corresponds to the word Sugar-loaf in our vernacular. The first appearance of this third anticlinal axis (Fig. 5), is a projection of thick layers of metamorphosed sandstone similar to those noticed in the synclinal section below. They rise here to the height of about two hundred feet, with a dip of about 45° toward the south, and terminating abruptly at the summit, the projecting and broken strata strew the surface with large fragments, producing a most inhospitable appearance, among which a few scattered Pines struggle to maintain their existence. The beautiful peaks of the *Mammelle* appear in the background, rising toward the clouds. The prominent rocks which give character to this mountain are those which form the northern side of the axis, and their inclination is probably 70°. This object, which seems at first to be a uniform cone, abruptly terminated or truncated, has all the appearance of a volcanic crater, but when beheld from a nearer point of view, and with the favoring influence of light and shade, shows itself to be composed of two peaks, and the illusion of a crater vanishes. The same rocks which form the northern slope of this axis are beautifully exhibited in a low range of escarpment, rising directly from the water to the height of one hundred and fifty feet, and forming a rocky wall, or barrier, to the river, which I have styled the *Palisades* (Fig. 6).



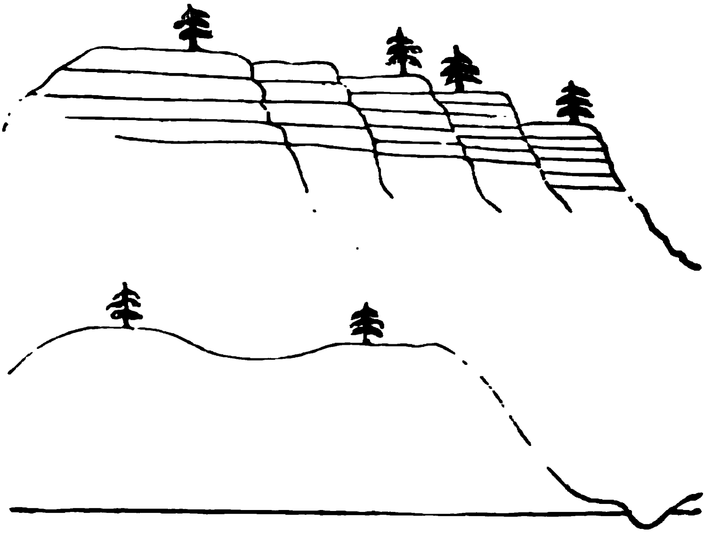
[Fig. 6.]

Above the stream which takes its name from the peak just now mentioned, and which, like its fellows, the tributaries of this river, flows in a wide excavation, frequently bounded by a range of mountains. To the southward, the elevation from the valley is marked by some curious strata of indurated rock projecting almost vertically from the surface, like walls several feet high. The alternating layers having been removed by erosion (Fig. 6). Similar projecting strata appear still more boldly in a low hill on the opposite side of the river. These I supposed to be identical, and believe them to be portions of a synclinal axis near this point, where the displacement of the strata is manifested in the highest degree, by the exaggerated dip of the rocks. With this portion of the river I was most agreeably impressed, not only by the inherent interest of the rocks just described, by the scenery of the bold and romantic *Palisades*, resting against the base of a beautifully tapering eminence, and by the fact that I was about to leave the region of violent upheaval, but here, also, it was my good fortune to witness a most glorious departure of the bright orb of day, as he sank peacefully and gorgeously to rest behind that beautiful and interesting object, the *Mammelle*.

The next section of interest is a fine escarpment of thick strata of extensive abrasions, but rears its high crest majestically, while its base forces the river to make a detour of several miles, affording the observer a fine opportunity of studying its formation on two sides, while with the aid of the valley of the *Petit Jean* creek, a third front is brought into view [Figs. 11 and 12]. The mountain is of a



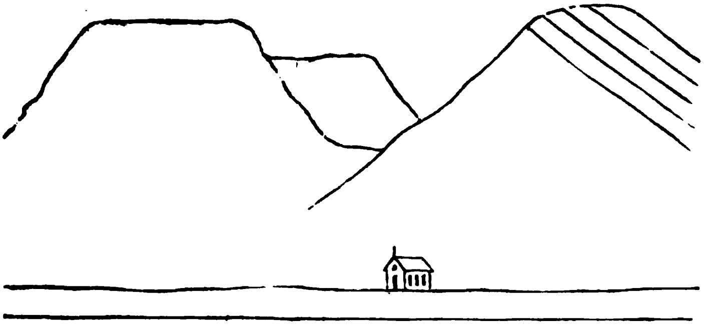
[Fig. 11.]



[Fig. 12.]

somewhat rectangular form; the summit being composed of a magnificent escarpment of thick layers of sandstone, which project boldly ; the separate masses occasionally rest athwart a ravine in such a way that the afternoon sun may shine through the apertures in a most curious manner, at a height of nearly one thousand feet. The sides of this mountain, except near the summit, where the cliffs are perpendicular, are sloping and broken with occasional terraces, characteristic of the coal measures, and here we enter fairly within the region of carboniferous rocks. The dip of the strata is very slight, but believed to be southerly. The connection, however, between the section here presented, and those of the low hills which have been noted in the fifty miles of the stream previously passed over, is not very satisfactory. I am, however, very well satisfied, that all the rocks from the granite to the coal, belong to the carboniferous era. No limestones were observed corresponding with the carboniferous or mountain limestone, and the strongly marked metamorphic character of the strata within thirty miles of the granite, and the absence of all distinct fossils, would naturally lead one to suppose that they belonged to an older group of sedimentary rocks ; as will be seen by an inspection of the specimens, however, certain forms were discovered in the indurated sand rock which bear a very close analogy to those found in the sandstones of the coal measures, to the lower members of which group I feel strongly disposed to refer them.

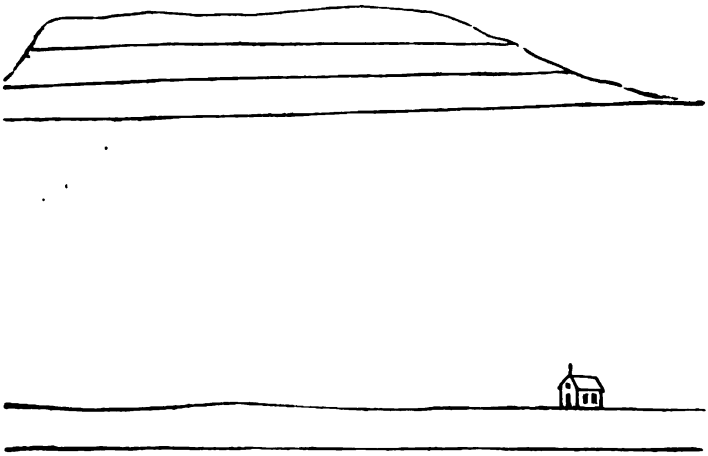
The coal formation, now decidedly entered, continues to occupy a large portion of the state toward the north-west, forming high ranges of hills. At Dardanelles, four hundred and fifteen miles from the mouth of the river, there is a high bold cliff of sandstone, rising abruptly from the river opposite Norristown [Fig. 13]. The strata are thick and have a strong northerly dip toward the river, which bends around the cliff, and for some distance follows the rocky base of the mountain, the plane of which is almost identical with that of



[Fig. 13.]

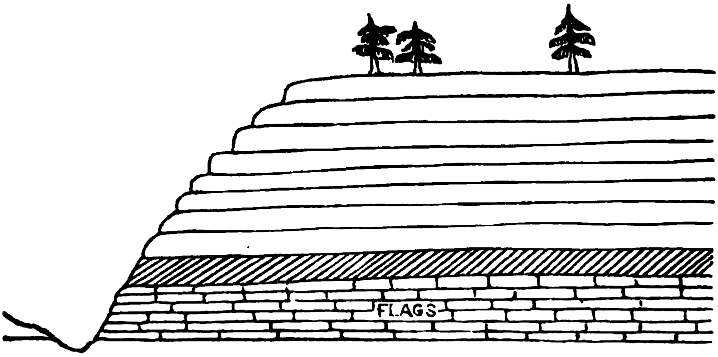
the strata on the north, while upon the south, the rocks are broken off, and the declivity is more abrupt, making this, the Dardanelle rock, a prominent and remarkable object. A widely excavated valley extends westward from this flourishing town, in which rises the *Magazine* mountain, which is visible from many points on the river, owing to its prominence amid the surrounding abrasions. This object was named by the early French settlers from its peculiarly regular house-like form; like the *Petit Jean* it is capped with sandstone forming cliffs; it appears rather a collection of mountains than a single pile, hence it presents a varying aspect from different points of view, although the straight lines of its summits give it a character by which it is easily recognized. Near its base is a salt spring, the relation of which to the adjoining rocks I did not ascertain.

Above Norristown, on the north bank of the river, the hills are chiefly composed of sand rock, having a dip parallel to those in the *Dardanelles*, and evidently overlying them; they are cut in their line of bearing, and form a bold front, with fine masses presenting on the side of the hill [Fig. 14].



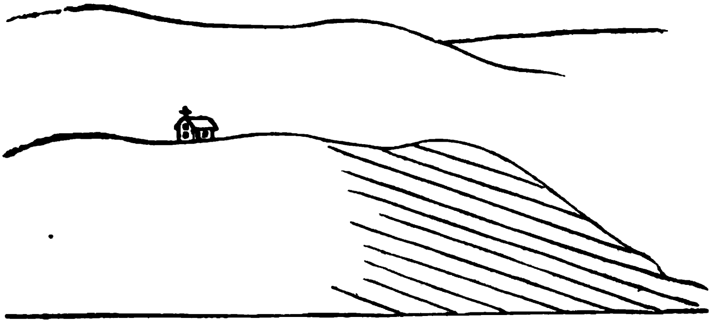
[Fig. 14]

Beyond Delaware, the Dardanelle range continues westward, with its strata dipping towards and running under the river, nor rising above two hundred feet, while above it, in the distance, the massive *Magazine* again appears, and so situated, that its cap rocks might easily be the same with those of the Dardanelle or the Norristown cliffs. We are now within the region of Pines, which constitute a leading feature in the landscape and give name to a tributary flowing from the north. Near its mouth is an interesting section of sand-rocks, with a slight northerly dip. The upper layers are massive, while here and there the peculiar characters of the coal formation are very manifest. Some strata terminate by thinning out abruptly, while others have the appearance of drifted sand, strongly resembling the recent alluvium so abundant on this stream ; some strata are very regularly broken into square blocks, so that the cliff resembles an artificial wall, and some of these, at the same time, appear to be fissile in an oblique direction, as though composed of many successive and gradual depositions [Fig. 15]. Below these, near low water-mark, are beautiful flags, while all of the thinner strata have distinct ripple marks and rain drops. Fossils are rarely seen, although they abound on the surface of the high grounds in the rear, where the soil is apparently composed entirely of the detritus of the subjacent sandstones, They consist chiefly of Lepido-dendrons, with perhaps some Calamites. Some of the former are large, and though broken remain in juxtaposition for several feet. Above this point a reef of rocks occurs in the river bed, in which the dip is northwardly ; this is the first reef observed in a river constantly obstructed by bars of moveable sands.

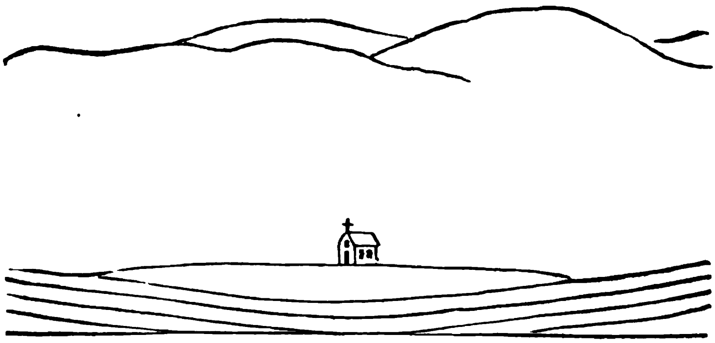


[Fig. 15.]

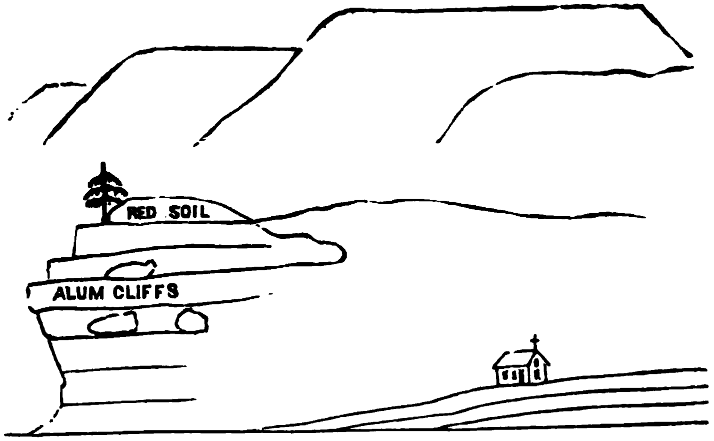
A few miles further up, at Pittsburgh [Fig. 16], is a low hill, composed of sandstones and shales, containing evidence of coal, dipping to the north at an angle of about 20°. At Spadra Bluffs [Fig. 17], we find the center of a synclinal axis; the landing is composed of shaly sand rock, beneath which is a layer containing curious kidney-shaped concretions, lying above a thick layer of solid sandstone that forms an excellent roof to a seam of coal, which here occurs at low water mark, and has been worked to some extent. In the rear of this vil-



[Fig. 16.]



[Fig. 17.]

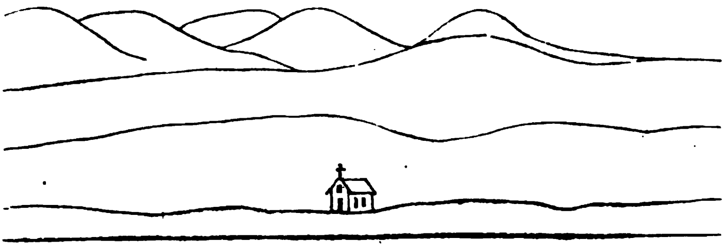


[Fig. 18.]

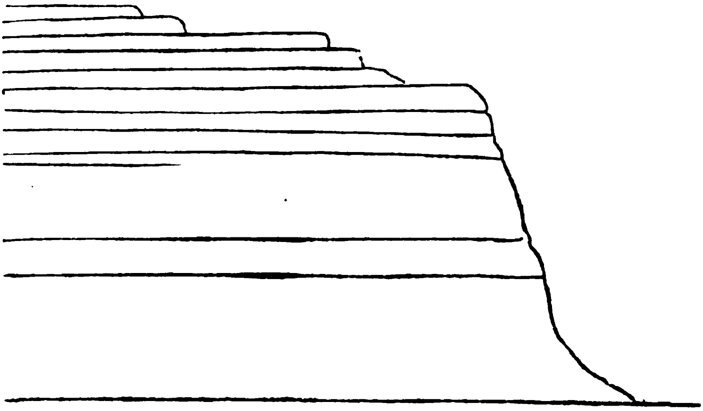
lage is a high range called the *Mulberry* mountain, having very different characters from those situated lower down the stream, which may be owing to the fact of its being synclinal. Its direction, like that of the other ridges, is north-east by east.

Twelve miles above Spadra, at Morrison's [Fig. 18], some curious cliffs occur, in which the sand rock is singularly eroded; large holes appear, which are said to be occupied as eagle's nests, but which are formed by the decomposition of certain elements of the stone, that result in its disintegration; hence this is called the *Alum Cliff*. Far in the distance the horizon is formed by the summits of the *Magazine* Mountain, to which we here bid a last farewell, as its blue outline mingles with the sky.

The next section [Fig. 19] which attracts attention, is that of the *Ozark* Mountains, a range parallel to the *Mulberry*, and like it, devoid of that peculiarly regular character previously noticed, being a continued series of gentle swells. Bold cliffs of three hundred feet in height are seen above the town of Ozark; some of these escarpments form bare walls, terminating abruptly, and presenting naked cliffs from their base to their summit, so that the different strata may be easily



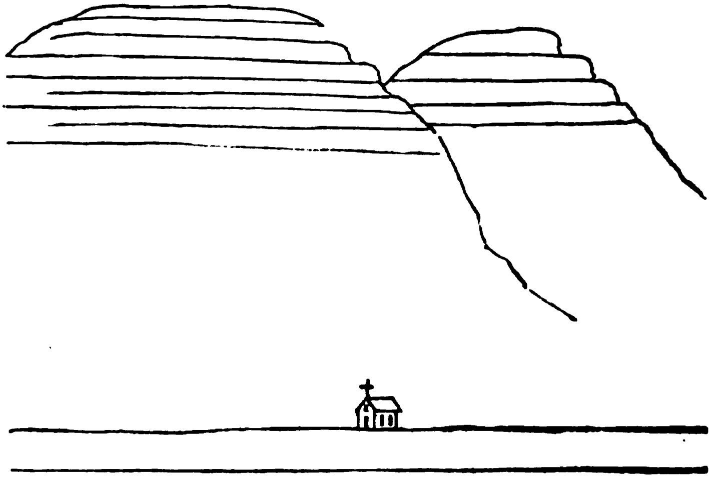
[Fig. 19.]



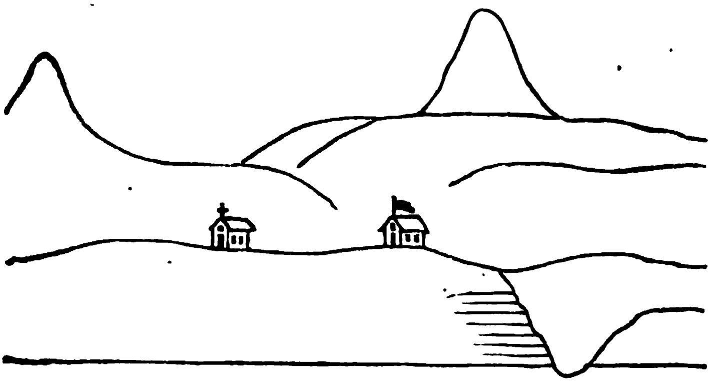
[Fig. 20.]

observed; among these a thick bed of coal occurs about midway. The dip is slightly toward the north [Fig. 20].

The hills of Van Buren are the next objects that attract attention. They are composed almost exclusively of sandstones, embracing one or more seams of coal, and show some fine cliffs [Fig. 21], teminating abruptly at the river, and extending a few miles above the town, while the range stretches far off in an easterly direction. Soon after leaving Van Buren, at a turn in the river, with a long reach up stream, a beautiful landscape presents itself [Fig. 22], with Fort Smith, our Ultima Thule, in the foreground, basking pleasantly in the sunshine, while the flag of our country waves cheerily under the influ-



[Fig. 21.]



[Fig. 22.]

ence of zephyrs from that mighty west, which here begins to stretch its interminable plains toward the sierras of the Rocky Mountains. In the back ground, forming a distant horizon toward the south, is a most beautiful mountain outline of ranges and peaks. Rising far up above its fellows, the regular cone of the *Poteau* mountain stands prëeminent, and in clear weather, perfectly distinct, though reputed to be forty miles distant [Fig. 22]. The rocks of this mountain are said to be sandstones marked with impressions of coal ferns. At the mouth of Poteau creek, which joins the Arkansas at this point, just beyond the state line, a sandstone occurs. South of the town, at a distance of a few miles, coal is excavated from the prairies, after removing from one to two feet of soil.

As it was not my good fortune to penetrate the Indian territory, I can only add, upon hearsay testimony, that the coal formation continues until the underlying carboniferous limestone crops out, as it does, beyond Talequah, in the Choctaw Nation, a specimen of which rock I procured, and found its characteristic animal fossils, and cherty structure, which extends through Washington county, just as it appears in the adjoining portions of Missouri.

I had hoped to present with these sections and memoranda, and as an appropriate contribution, a catalogue of the plants of this State, which have been studied to some extent. Application was made to the persons possessed of the information needed, but no aid has been received, so that the brief notes taken upon the journey made during February, when vegetation was in repose, I am able only to furnish the following list, kindly arranged by my friend, Jas. W. Ward, of Cincinnati. It is given merely as an indication of the Flora of Arkansas.

Indications of the Flora of Arkansas.

MAGNOLIACEÆ—
    Magnolia tripetala.
ANONACÆ—
    Asimina triloba.
VIOLACEÆ—
    Viola pedata.
      " cucullata.
      " rotundifolia.
      " pubescens.
ZANTHOXYLACEÆ—
    Zanthoxylum americanum (fraxineum, Willd).
ANACARDIACEÆ—

- Rhus glabra.
- Rhus toxicodendron.

TILIACEÆ—
- Tilia americana.
- " heterophylla.

VITACEÆ—
- Vitis cordifolia.
- " riparia.
- " rotundifolia (Muscadine).
- Ampelopsis quinquefolia.

ACERACEÆ—
- Acer pennsylvanicum.
- " saccharinum.
- Negundo aceroides.

HIPPOCASTANACEÆ—
- Æsculus pavia (shrub.)

CELASTRACEÆ—
- Euonymus atropurpureus.
- " americanus.

LEGUMINOSÆ—
- Gymnocladus canadensis.
- Cercis canadensis.
- Robinia pseudocacia.
- Gleditschia triacanthos.
- Amorpha fruticosa.

ROSACEÆ—
- Rosa carolina.
- Rubus canadensis.
- " villosus.
- " occidentalus.
- Amelanchier botrapium.
- Prunus chicasa.
- Cerasus virginiana.

GROSULACEÆ—
- Ribes rotundifolium.

CACTACEÆ—
- Opuntia vulgaris.
- Melocactus ?

SAYIFRAGACEÆ—
- Saxifraga virginiensis.

UMBILLIFERÆ—
- Archangelica hirsuta ?

CORNACEÆ—

Cornus florida.
" circinata.

LORANTHACEÆ—
Viscum flavescens. [illegible]

CAPRIFOLIACEÆ—
Symphoricarpus vulgaris.
Sambucus canadensis.
Viburnum prunifolium.
" ?

RUBIACEÆ—
Hedyotis minima.

ERICACEÆ—
Vaccinium stamineum.
Andromeda arborea.

AQUIFOLIACEÆ—
Ilex opaca.
Prinos verticillata. [illegible]

MYRICACEÆ—
Myrica cerifera.

BIGNONIACEÆ—
Tecoma radicans. [illegible]
Bignonia capreolata.

EBENACEÆ—
Diospyros virginiana.

VERBENACEÆ—
Verbena angustifolia.
" spuria.
Lantana camara ?
Callicarpa americana (Bermudian mulberry).

OLEACEÆ—
Chionanthus virginicus.
Fraxinus quadrangulata.

ULMACEÆ—
Ulmus fulva.
" racemosa. alata
" americana.
Celtis occidentalis.

JUGLANDACEÆ—
Juglans nigra.
Carya porcina (Nuttal—Glabra, Willd).
" aquatica.
" olivæformis.
" amara.

CUPULIFERÆ—

Quercus alba.
" rubra.
" nigra.
" bicolor.
" falcata.
" obtusiloba.
" palustris.
" pumila ? dwarf.
Castanea pumila (chinquapin).

SALICACEÆ—

Salix discolor.
" ?
Populus angulata.

BALSAMIFLUÆ—

Liquidambar styraciflua.

PLATANACEÆ—

Platanus occidentalis.

URTICACEÆ—

Morus rubra.
Maclura aurantiaca.

CONIFERÆ—

Taxodium distichium.
Pinus inops.
Juniperus virginiana.

NYSSACEÆ—

Nyssa multiflora.

LAURACEÆ—

Sassafras officinale.
Benzoin odoriferum.

LILIACEÆ—

Yucca filamentosa.
" augustifolia.

SMILACEÆ—

Smilax ?

CYPERACEÆ—

Cyperus ?
" ?
Cyperus.

GRAMINEÆ—

Miegia macrosperma.
Digitaria sanguinalis.
Bromus.

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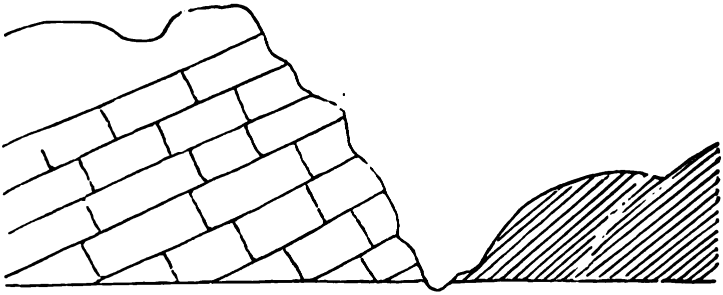
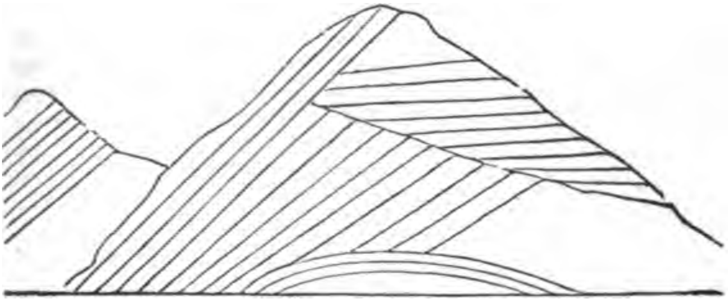
indurated rock, above Benedict's wood-yard, rising about two hundred feet, and presenting a bold, rugged character [Fig. 7]. Beneath these layers a greenish shale emerges near the bed of a creek, beyond which the same strata continue, forming low hills, in one of which, just below the mouth of the Cadron creek, is the last evidence of violent upheaval which I observed. The ridge terminating abruptly in the river presents a most curious section, which I have styled an *anticlinal fault* (Fig. 8). At low water mark continuous curved strata appear; resting unconformably upon these, and beyond their exposition on either hand, are strata of a slaty sandstone, which are terminated midway up the cliff by a long line, upon which similar layers rest, also unconformably.

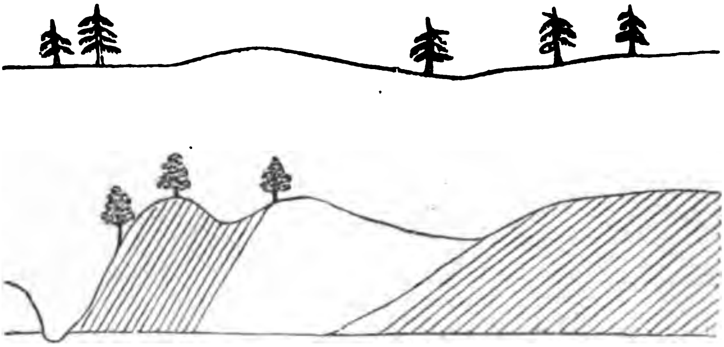


[Fig. 7.]



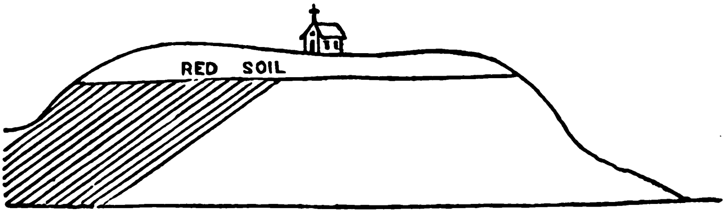
[Fig, 8.]

Above Cadron (Fig. 9), low hills, clothed with cedar, present themselves, in which are observed strata of finely laminated sand-rocks, overlying greenish shales scarcely indurated, alternating with silicious strata that appear at the Jenny Lind Warehouse. These strata have a southerly inclination, are curved at the latter point, and are believed to be identical with those below Cadron creek, which will appear the more apparent when, upon consulting the map, we observe a violent turn in the river, bringing us back in its course, to sections previously passed over. The background of the landscape for many miles is composed of the regular and continuous hills which I have designated the Perry county Range, with its scattered fringe of pines resting against the sky (Fig. 9).



[Fig. 9.]

Apparently emerging from beneath the rocks last mentioned thin layers of sandstone among shales, were observed at the town of Lewisburgh (Sec. 7). The dip of these strata is southerly, hence I say *apparently emerging*, for the distance is considerable, and no intermediate observations enabled me satisfactorily to trace the connection. This section shows a peculiar red colored deposit of soil, different from any previously observed. Upon it grows the Papaw, and a dwarf species of the *Æsculus*. In the distance, the *Petit Jean* mountain presents itself (Fig. 10). This mass stands isolated by



[Fig. 10.]

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